
Neutral Atom Imaging of Solar Wind Interaction With the Earth And Venus

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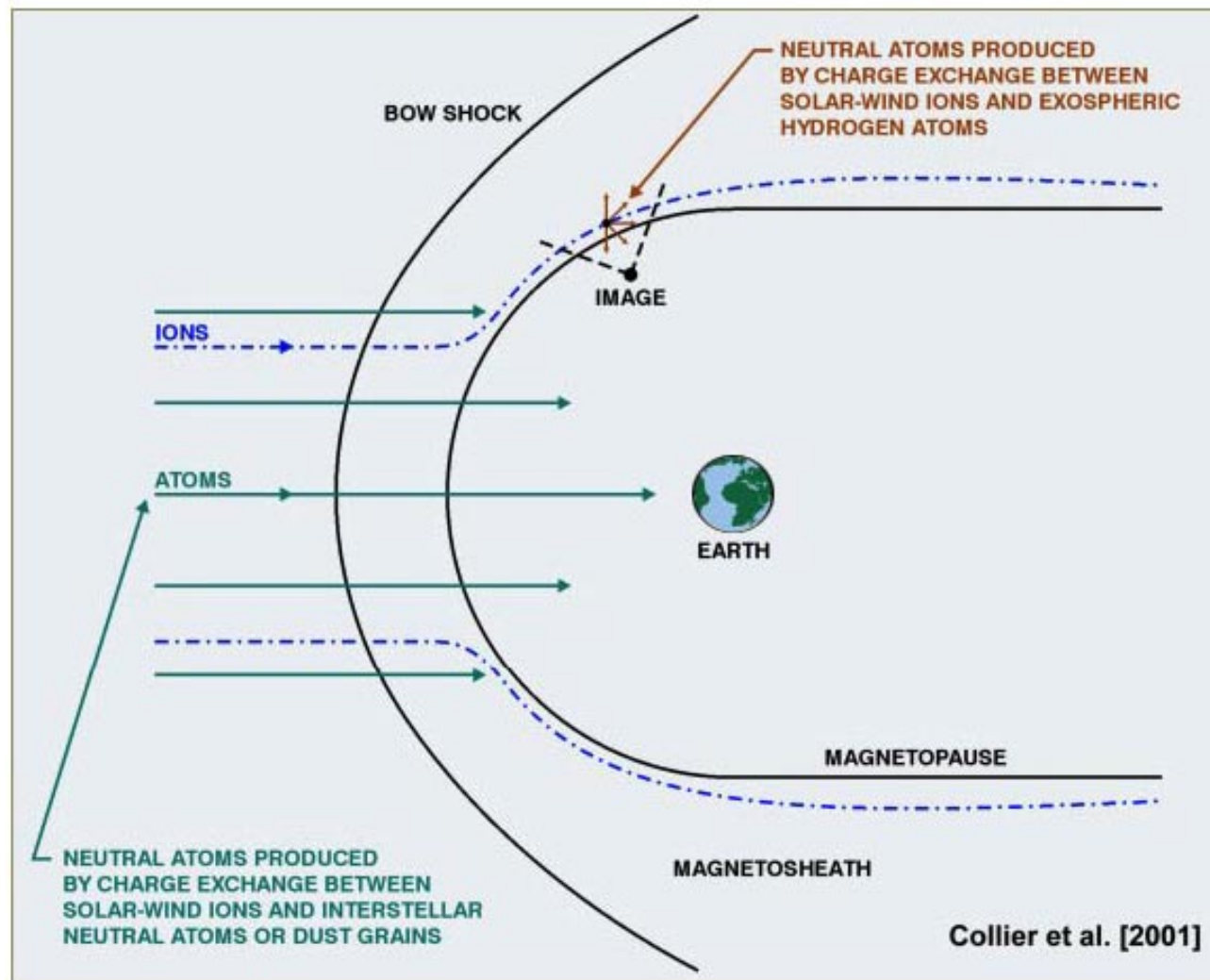
T. Tanaka
Kyushu University, Japan

April 10, 2003
EGS-AGU-EUG Joint Meeting
Nice, France

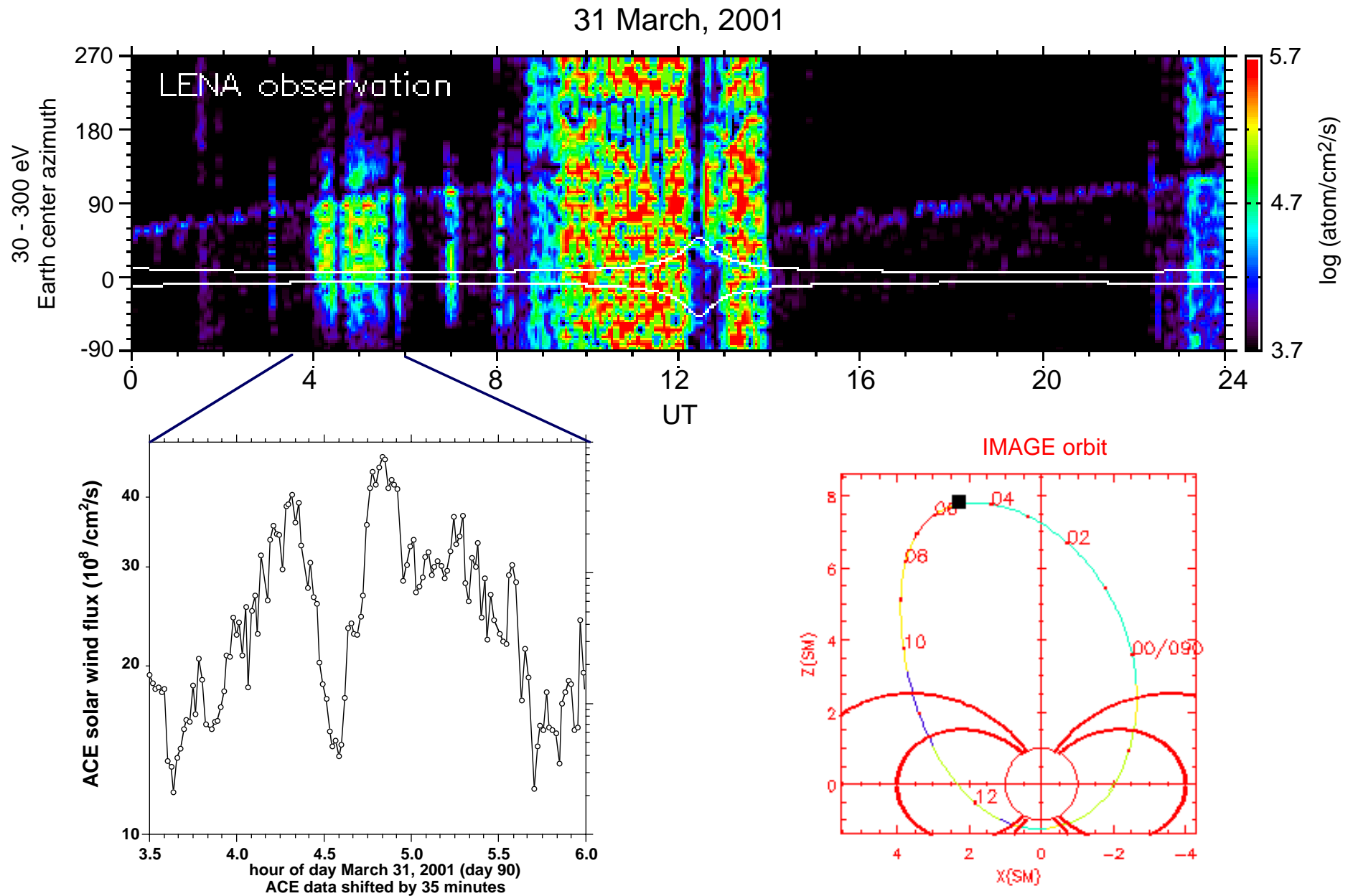
Outline

- Solar wind - magnetosphere interaction seen by IMAGE/LENA (Low Energy Neutral Atom) imager
- Solar wind interaction with Venus ionosphere and upper atmosphere
- Simulation of LENA emissions on Venus
 - Tanaka's MHD model
 - VIRA exosphere model

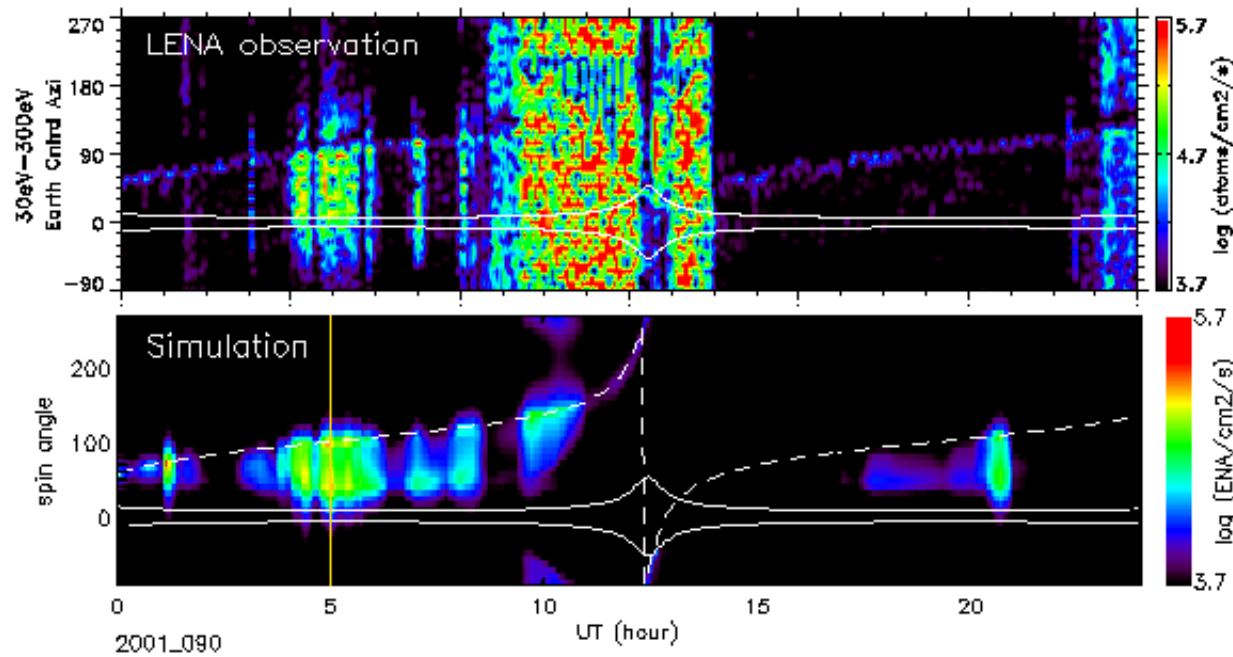
Neutral Atom Emissions in the Terrestrial Magnetosheath



IMAGE/LENA Magnetosheath Emissions on 31 March 2001

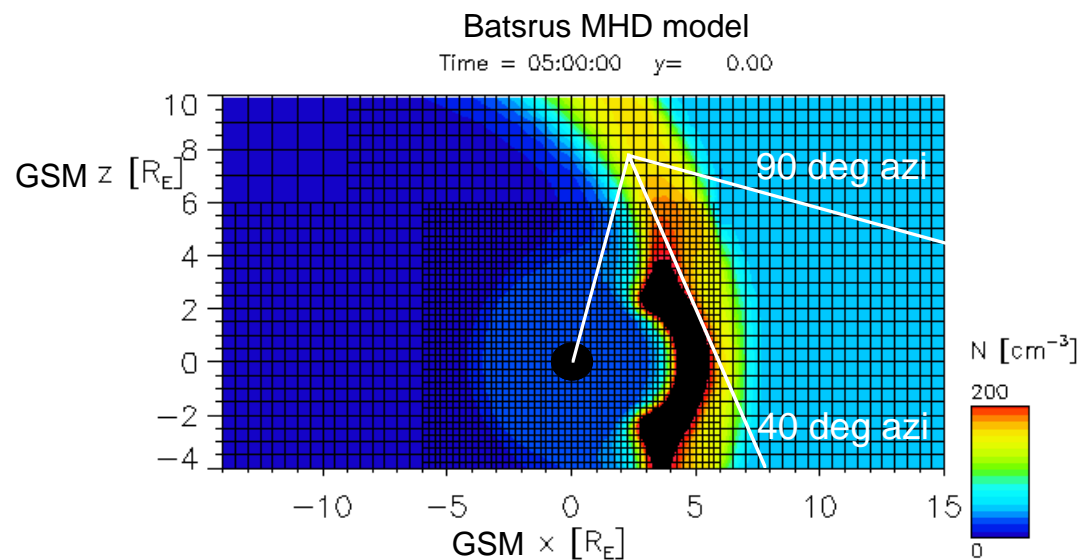
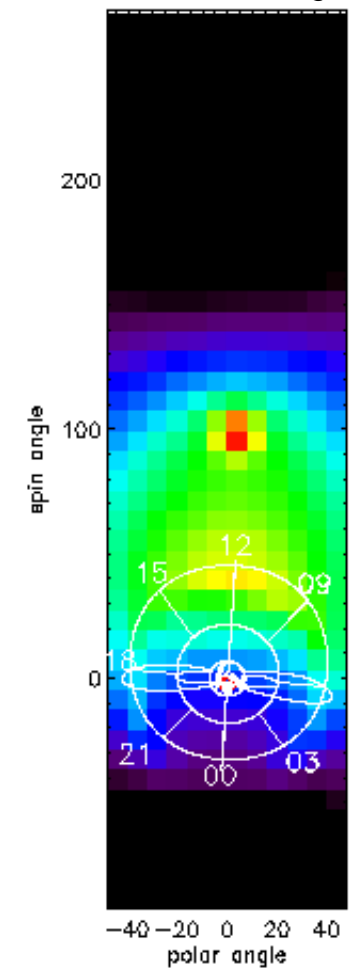


LENA Observed Magnetosheath Response to Extreme Solar Wind Conditions

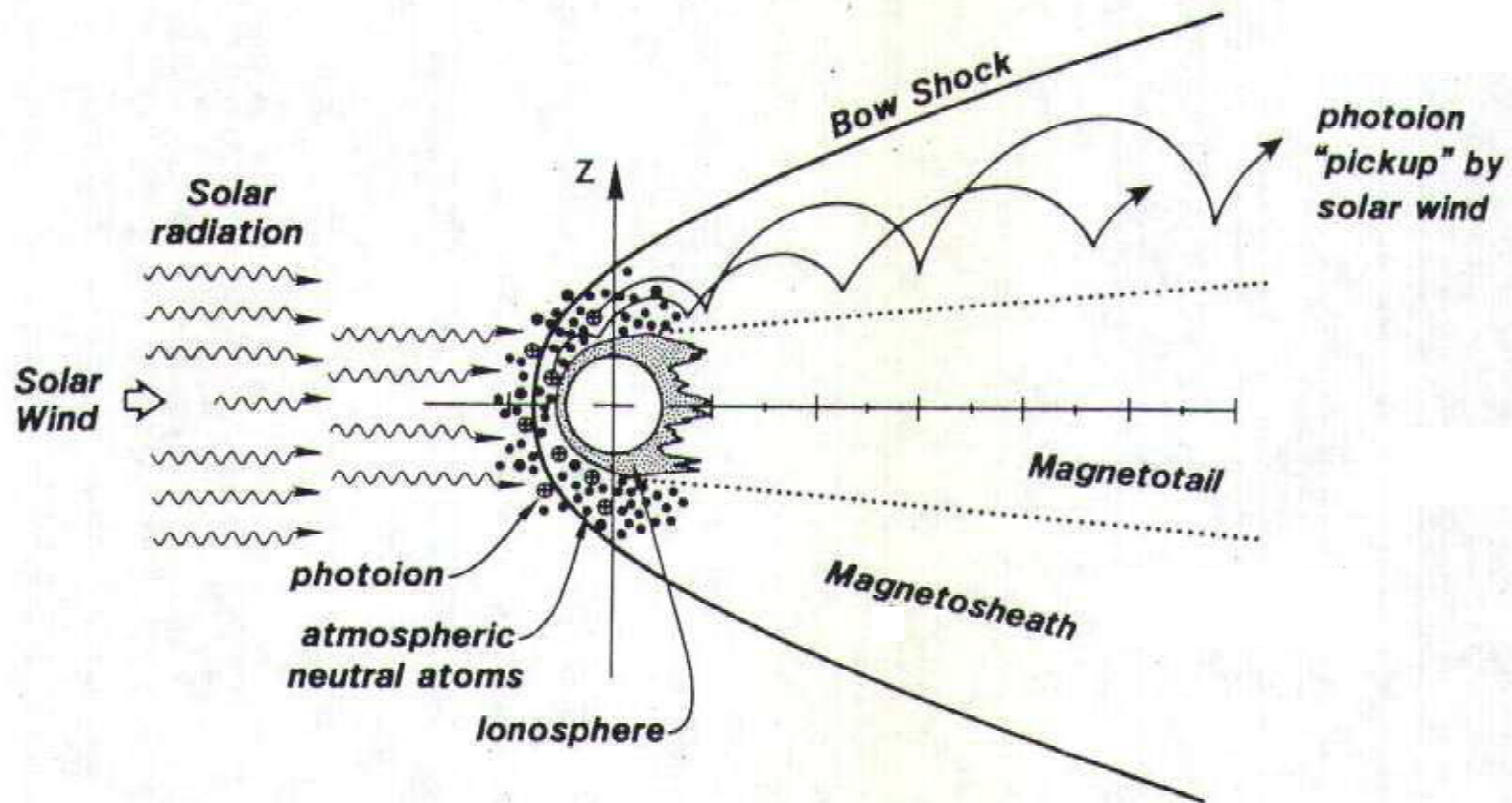


2001_090 05:00
pos (SM): 2.26 0.01 7.76

simulated image



Solar Wind Interaction with Venus Atmosphere

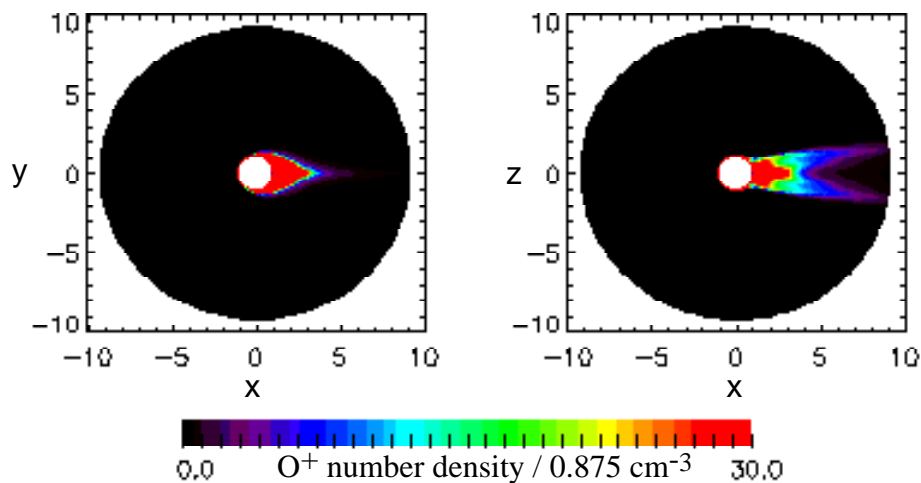
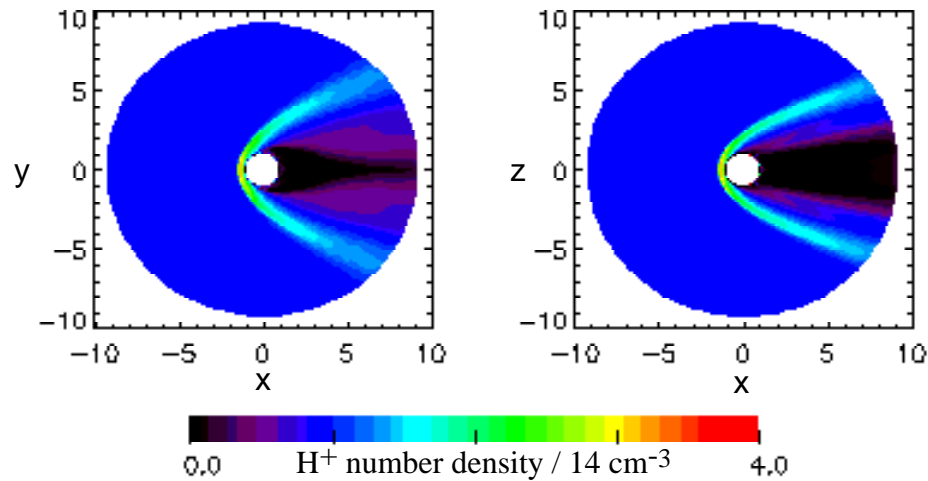


[Taken from Donahue and Russell, 1997]

Tanaka's MHD simulation of Solar Wind Interaction with the Venusian Ionosphere

Tanaka's MHD Model

$V_{sw} = 311 \text{ km/s}$, $N_{sw} = 14 \text{ cm}^{-3}$, IMF $B_z = 14 \text{ nT}$

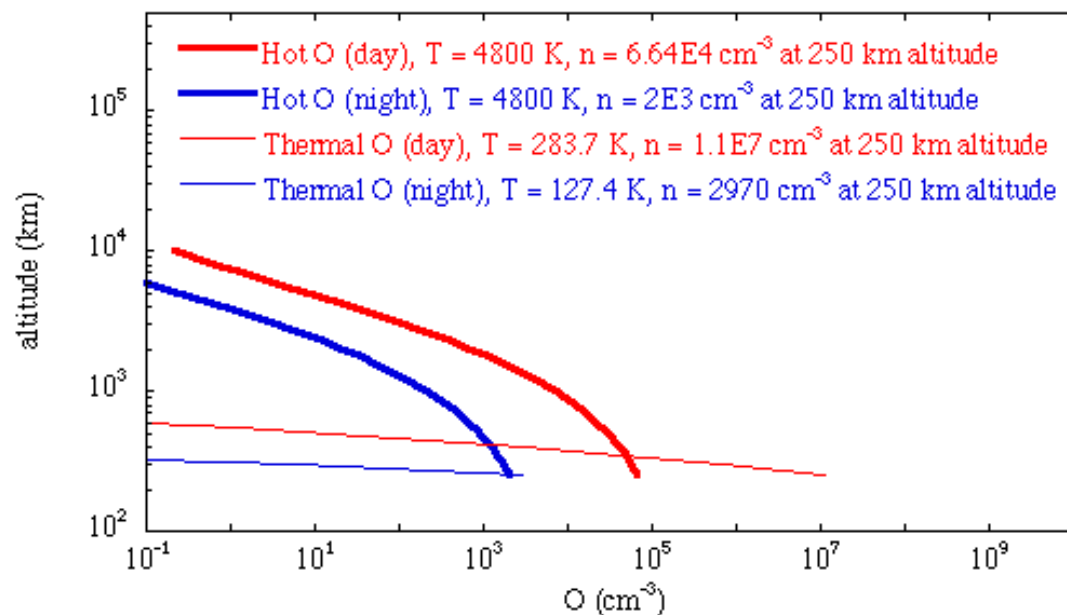
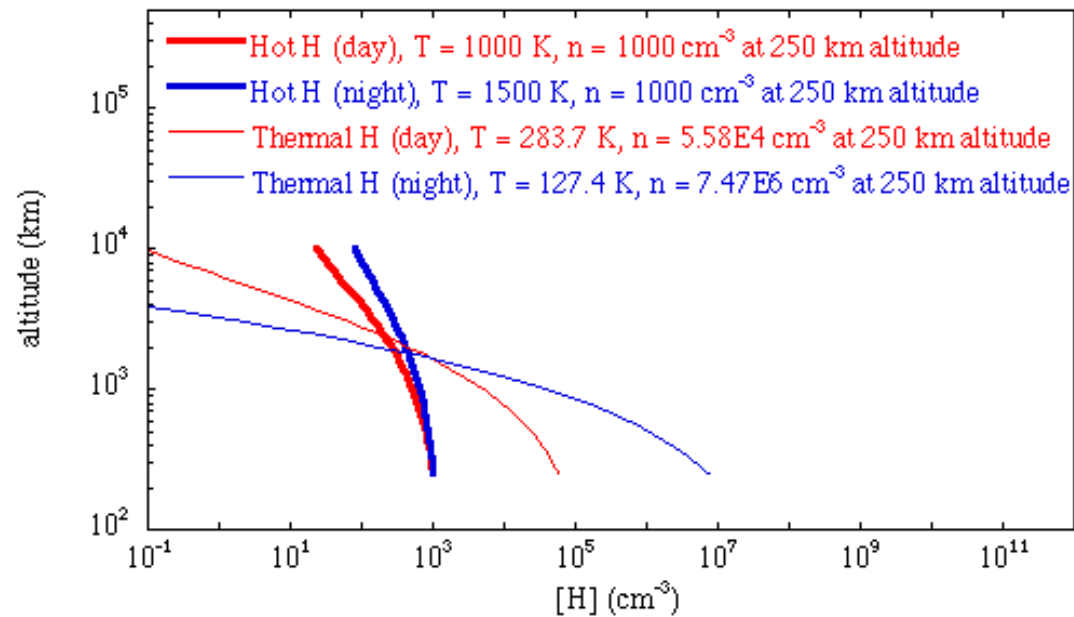


O^+ are created by:



Assume H^+ and O^+ have the same flow velocity and temperature

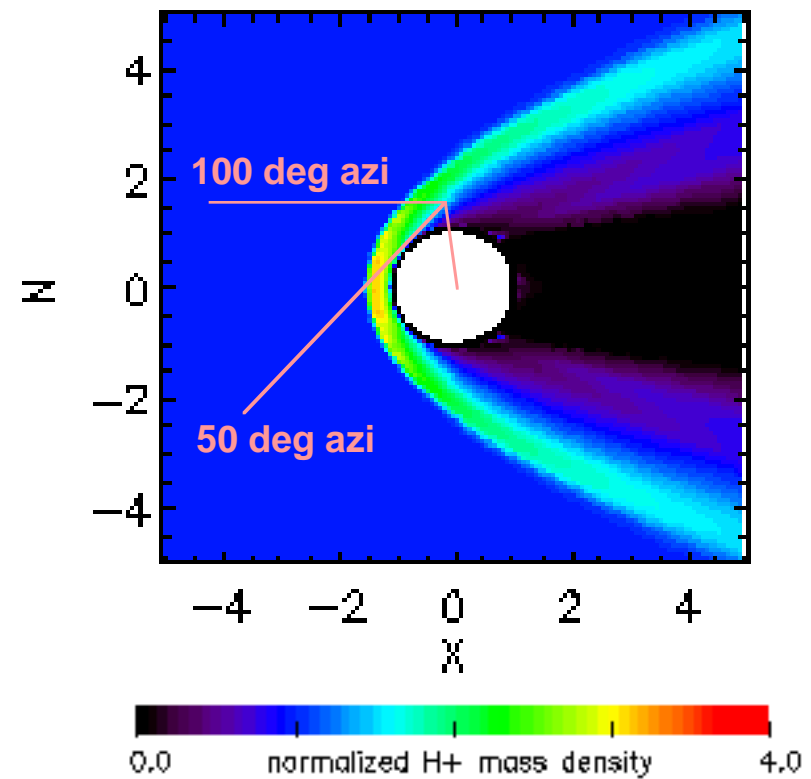
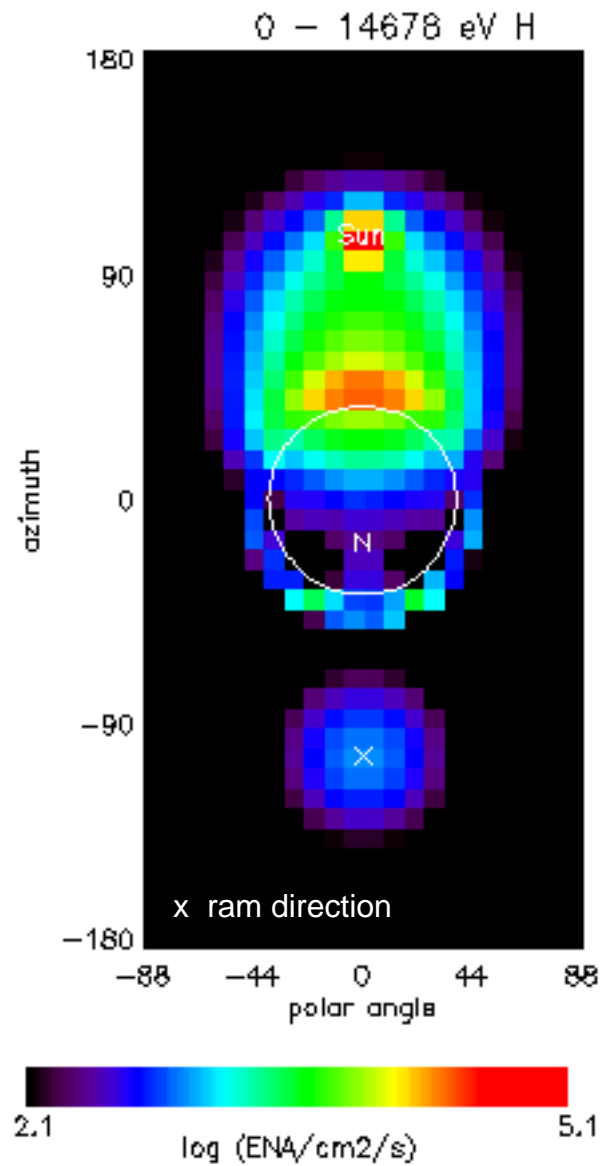
Venus International Reference Atmospheric (VIRA) Model



Simulated Venus LENA Image: H

20071031 14:59

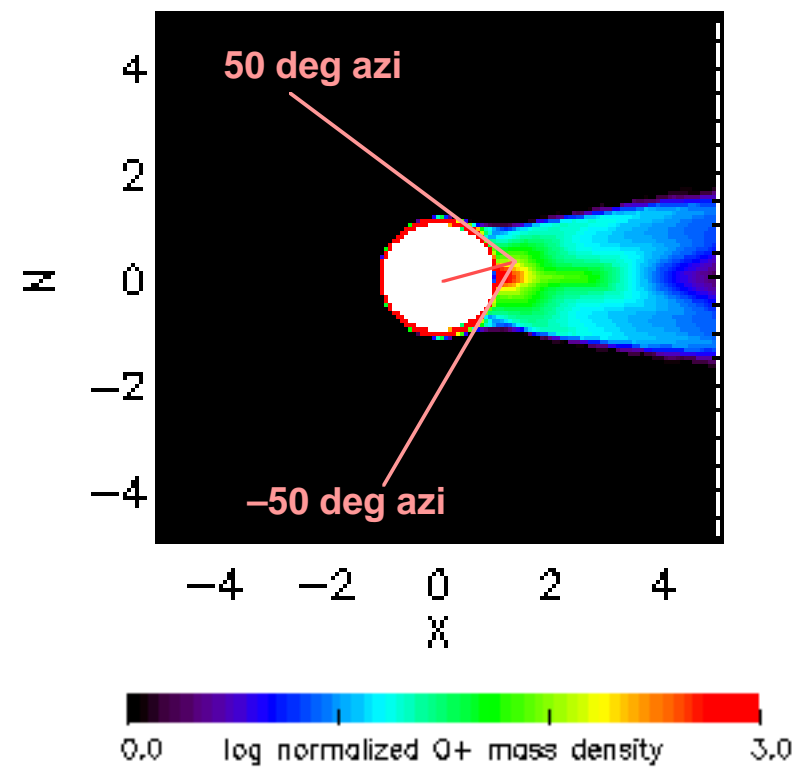
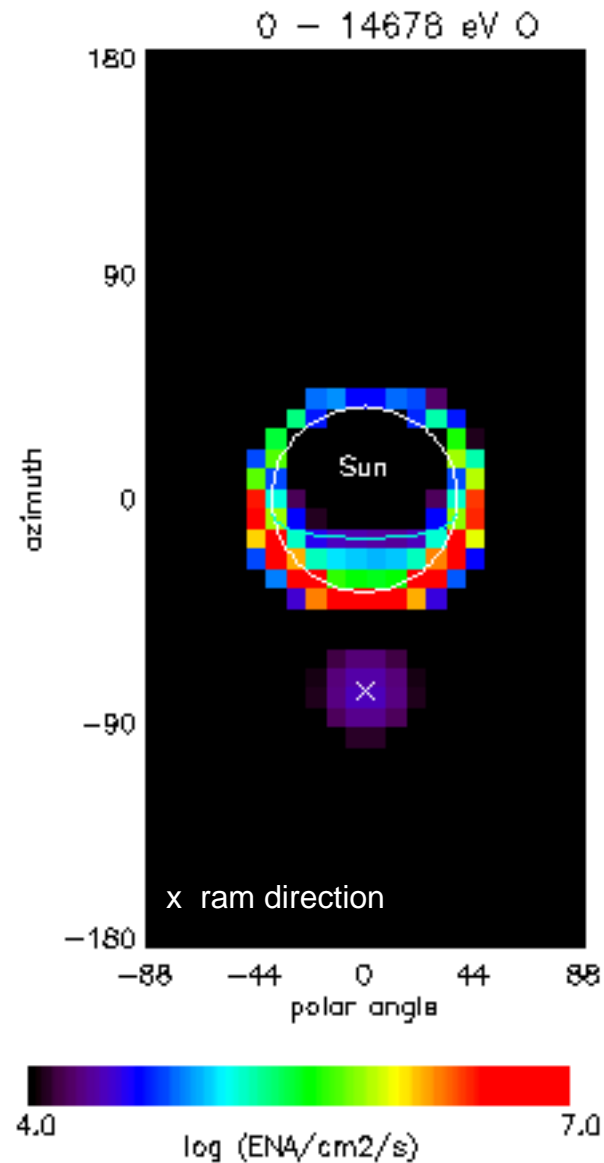
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Simulated Venus LENA Image: O

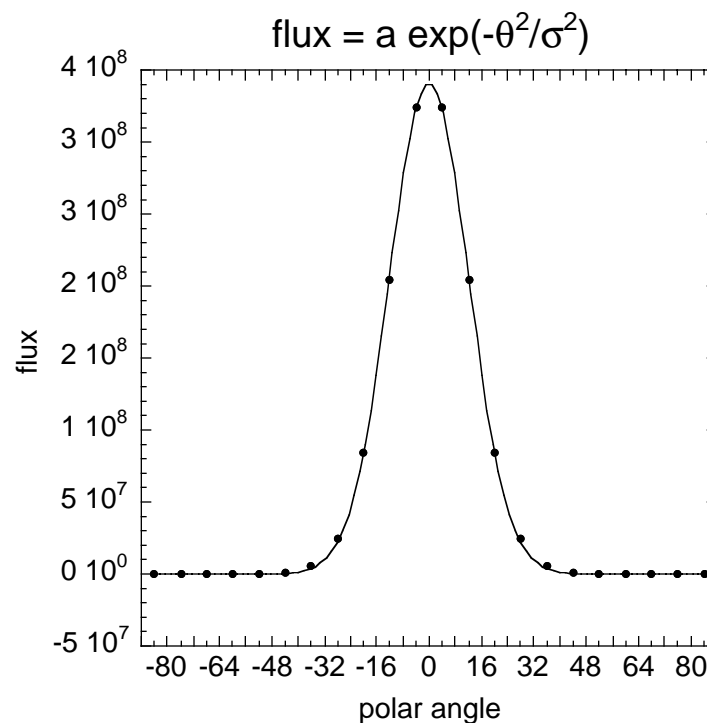
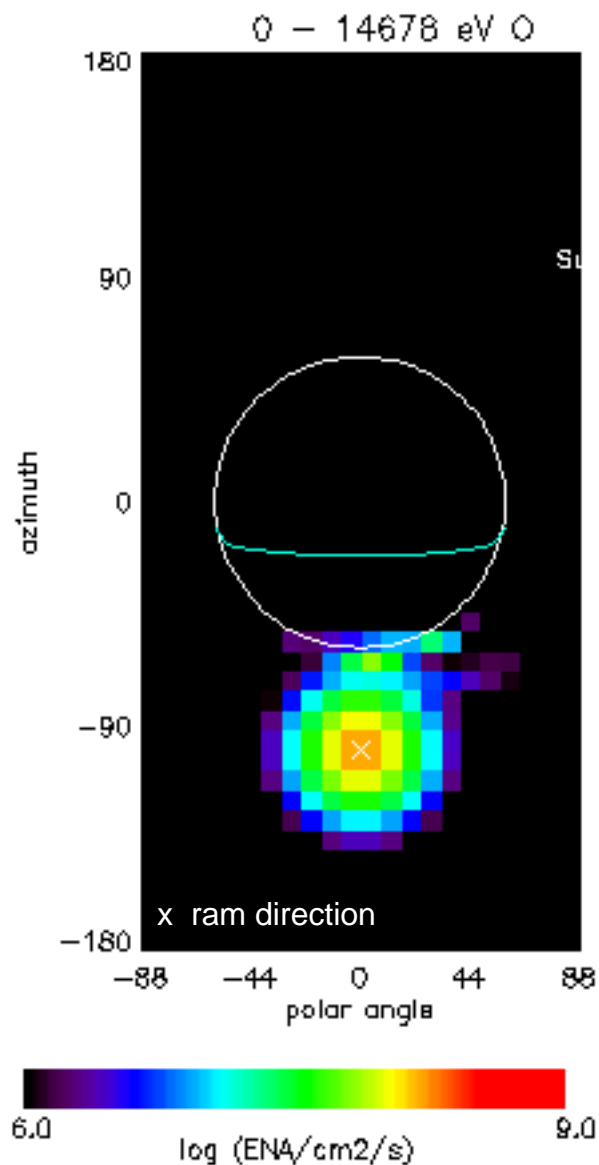
20071031 15:58

s/c pos (tt): 1.63 0.00 0.31 RV



Finding in-situ Temperatures and Densities of Hot Neutrals from Ram Signals

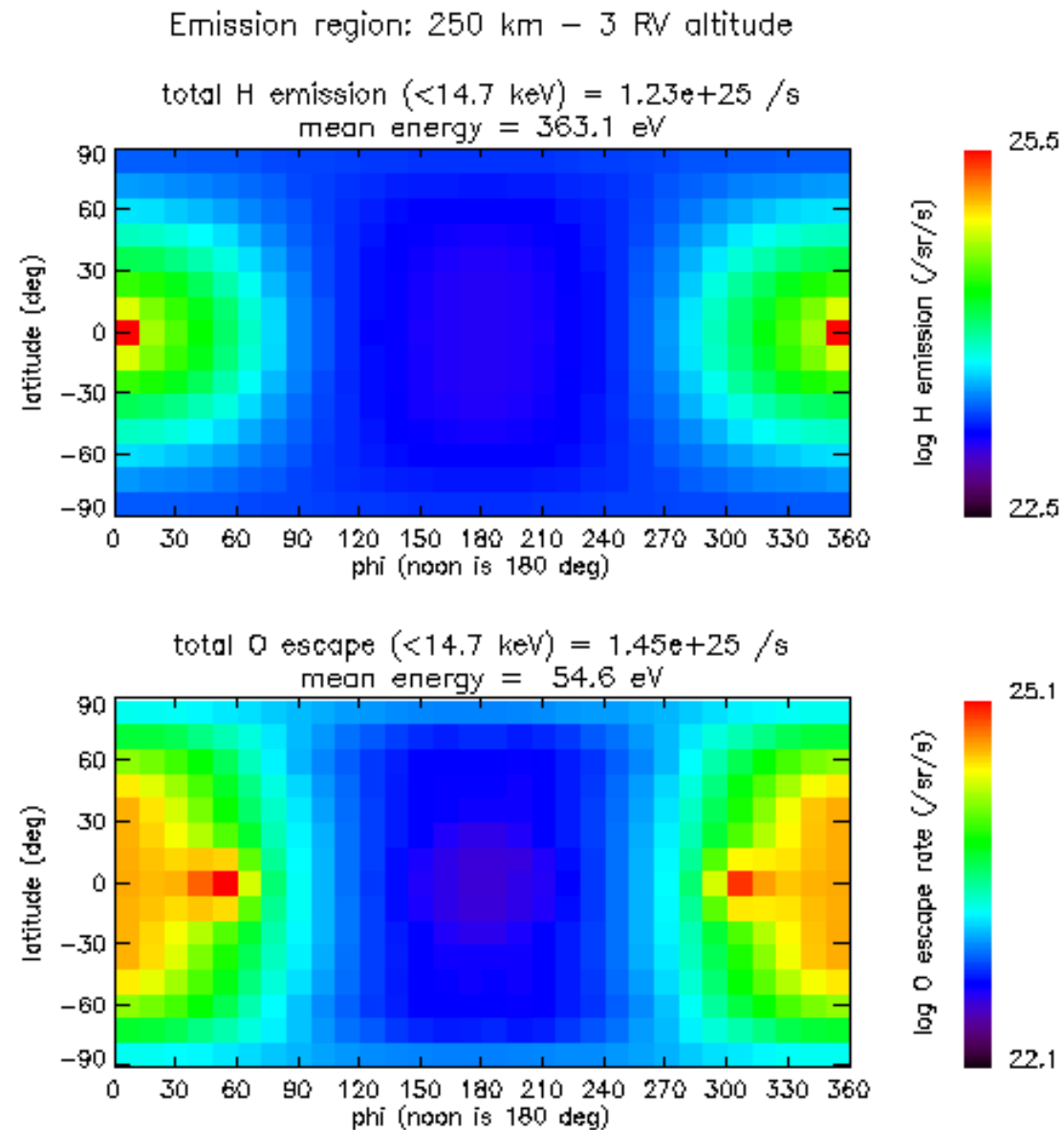
20071031 16:57
s/c pos (tt): 0.00 -1.17 -0.08 RV



Temperature:
 $\tan \sigma = V_{th}/V_{s/c}$
 $V_{th} \rightarrow T$

Density:
 $n = (\text{total flux}) / V_{s/c}$

Energetic Neutral Atom Emission and Escape Rates



Summary

- Neutral atom image has been proven as a new tool for studying the solar wind interaction with the terrestrial magnetosphere. Locations of the magnetopause and cusps can be deduced from neutral atom images.
- Simulation study has shown significant low-energy (0 – 10 keV) neutral atom emissions from Venus.
- Venus magnetosheath emissions have similar features and comparable intensity as those from the Earth during extreme solar wind condition.
- Low-energy neutral O image from Venus can be used to probe the location of the ionopause.
- The estimated total O escape rate from Venus is $\sim 1.5 \times 10^{25} \text{ s}^{-1}$.
- Future works:
 - Future Venus mission should carry LENA-type instrument.
 - Non-MHD modeling of O^+ on Venus